【Grant-in-Aid for Scientific Research (S)】

Molecular mechanisms linking floral transition and stem elongation in plants

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Purpose and Background of the Research

The stem is a primary structural axis of plants that supports aerial organs such as leaves and flowers. The shoot apical meristem (SAM) produces leaves during the vegetative phase and flowers during the reproductive phase (Fig. 1). The stem of the monocot model plant, rice, and the dicot model plant, Arabidopsis, do not elongate during the vegetative phase but do so just after the phase change (Fig. 2). Stem elongation just after flowering or bolting is also observed in many vegetables. How does a plant regulate flowering and stem elongation? FT is a known flowering hormone that can trigger flowering (Fig.3). Gibberellin (GA) is well-known plant hormone that stimulates stem elongation. In rice, endogenously produced GA is essential but is not sufficient to induce the stem elongation. Nagai *et al.* (2020) identified the *ACE1* and *DEC1* genes that regulate stem elongation in rice in the presence of GA. However, the molecular mechanisms that link the flowering and stem elongation in plant are still unclear. In this project, we aim to elucidate the molecular mechanisms that link floral transition and stem elongation in rice and Arabidopsis.

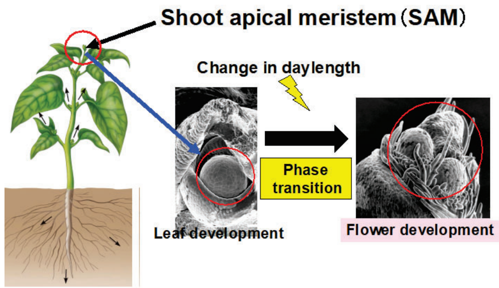

Fig 1. Shoot apical meristem produces leaves during the vegetative phase and flowers at the reproductive phase

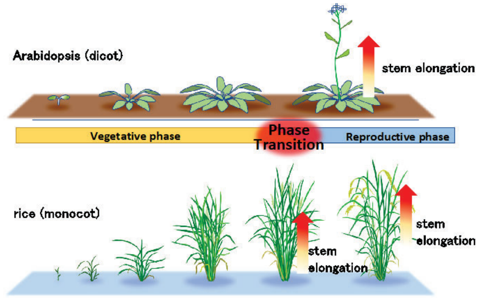

Fig 2. Stem elongation occurs after phase transition

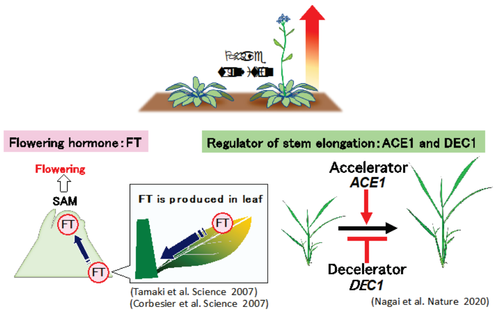

Fig 3. Flowering hormone and regulators of stem elongation

In addition, we use liverwort (*Marchantia polymorpha*), which is the basal land plant model for this project. Liverwort has a stem-like structure called 'stalk', which elongates during the phase transition of the vegetative to the reproductive stage (Fig.4). We also will identify the mechanism of link the phase change and stalk elongation in liverwort.

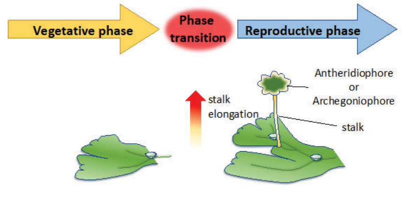

Fig 4. Seta elongation after phase transition in *Marchantia polymorpha* L.

Expected Research Achievements

In this project, we will determine how FT regulates *ACE1* and *DEC1*. We will also identify genes regulating the expression of *ACE1* (ACE1-like) and *DEC1* (DEC1-like genes) during the phase transition into flowering (Fig.5). Because stem elongation is stimulated by the plant hormone GA through the activation of cell division and elongation, we will also investigate the temporal and spatial production of GAs during the phase change.

This project is a collaborative effort among four researchers. Dr. Ashikari and Dr. Tsuji are in charge of elucidating the mechanisms that link flowering and stem elongation in rice. Dr. Imaizumi and Dr. Mizutani are responsible for elucidating these mechanisms in Arabidopsis and liverwort (Fig.6). The overarching goal of the project is to fully understand the molecular underpinnings that link flowering and stem elongation in rice, Arabidopsis and liverwort, and establish how these mechanisms converged or diverged throughout the process of plant evolution (Fig.7).

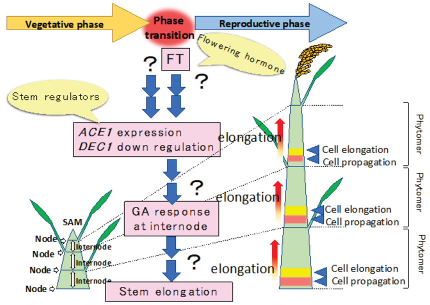

Fig 5. Elucidating molecular mechanisms linking floral transition and stem elongation in plants

Fig 6. Project members

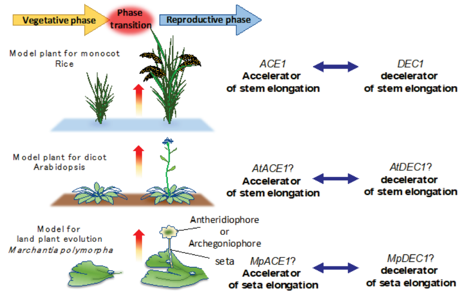

Fig 7. Research goals of the project

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